Polymer Derived Yttrium Silicate Cermai Matrix Composite Hot Structure Materials for Atmospheric Entry Vrhicles, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Through the proposed SBIR program, NanoSonic will provide NASA with next-generation, polymer derived yttrium silicate ceramic matrix composites (CMC) helically wound and reactively bonded to high temperature titanium alloy and carbon / carbon (C/C) substrates. NanoSonic's CMC's will consist of filament wound silicon carbide fibers embedded within a polymer derived yttrium silicate host matrix that has demonstrated thermo-oxidative durability in excess of 2,000 ^{O}C. NanoSonic's filament winding CMC manufacturing process will have immediate, cost-effective scalability enabling integration within reusable, multifunctional hot structure technologies for atmospheric entry vehicles including leading edge, fuselage, and tank structures. NanoSonic is currently developing lightweight, high temperature composite wrapped gun tubes and will leverage this expertise to produce game-changing filament wound CMC's with broad applicability in future NASA hot structure systems that are low-cost, lightweight, damage tolerant, and reusable. In support of a rapid Phase III transition, NanoSonic has generated significant defense prime interest in the proposed filament wound, polymer derived CMC technology and has an established pilot scale HybridSil manufacturing infrastructure that may transition down-selected resins to 55-gallon batch production quantities.

Anticipated Benefits

NanoSonic's filament wound, polymer derived CMC's will provide a game-changing reusable, lightweight, and damage tolerant hot structure technology to NASA and aerospace engineers for next generation atmospheric entry vehicles. The proposed CMC materials will serve as an enabling technology for reusability between atmospheric entry missions and have near-term integration pathways within primary load-carrying aeroshell structures, control surfaces, and propulsion system components.

Secondary non-NASA applications will include use within a broad spectrum of commercial and defense aerospace propulsion systems. By providing unprecedented combinations of manufacturing ease, high temperature durability, damage tolerance and multi-mission reusability, NanoSonic envisions considerable post applications for its polymer derived yttrium silicate CMC technology during Phase II and III efforts with its aerospace development partners.

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Small Business Innovation Research/Small Business Tech Transfer

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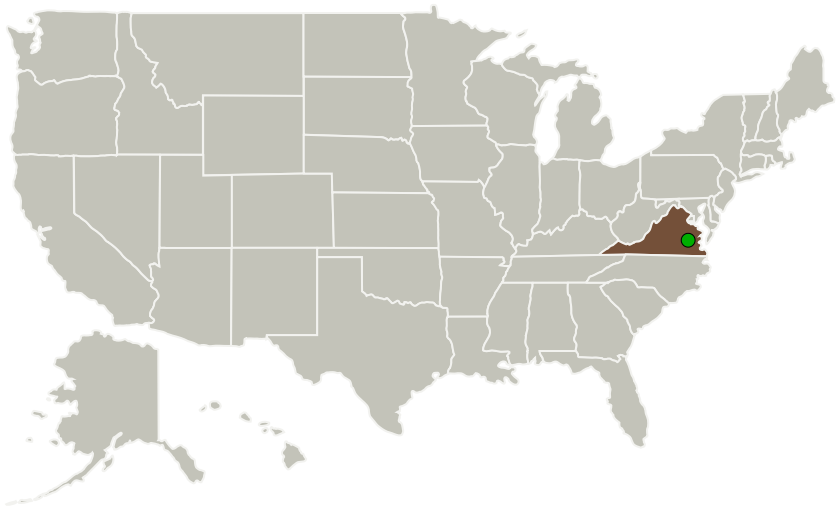
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Nanosonic, Inc.	Lead Organization	Industry	Pembroke, Virginia
Langley Research Center(LaRC)	Supporting Organization	NASA Center	Hampton, Virginia

Primary U.S. Work Locations
Virginia

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137881)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Nanosonic, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

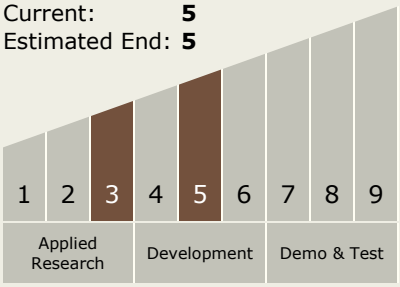
Carlos Torrez

Principal Investigator:

Victor V Baranauskas

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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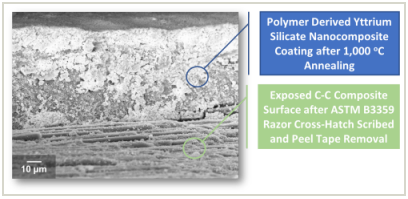
Images

Briefing Chart Image
Polymer Derived Yttrium Silicate Cermai Matrix Composite Hot Structure Materials for Atmospheric Entry Vrhicles, Phase I
(https://techport.nasa.gov/image/136964)



Final Summary Chart Image
Polymer Derived Yttrium Silicate Cermai Matrix Composite Hot Structure Materials for Atmospheric Entry Vrhicles, Phase I
(https://techport.nasa.gov/image/126184)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.4 Manufacturing
    - TX12.4.1 Manufacturing Processes

Target Destinations

Earth, Mars, Others Inside the Solar System